AN APPROACH TO THE DESIGN OF FORMAL AND INFORMAL EDUCATION SERVICES FOR THE SYSTEM ARCHITECTURE: THE LENS OF ORGANIZATION, COMPETENCE, PEDAGOGY, AND TECHNOLOGY CATEGORIES

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Abstract: The paper presents an approach to a design of formal and informal education services for the system architecture developed within the European Union Erasmus+ eMediator project. An 'Education as a services' approach requires a specific design of elements that rely on four components: organization, competence, pedagogy, and technology. Artificial intelligence will serve as a tool that enables performance of all functions from each component. This study concentrates on a specific design of educational services that would correspond to the four components. It relies on use case method that allows for identification, clarification, and organization of elements crucial for the system requirements. In the future, the designs of educational services can be used in other systems that are developed for educational purposes.

Keywords: system architecture development, artificial intelligence-based platform, educational services, mobile education platform

1. INTRODUCTION

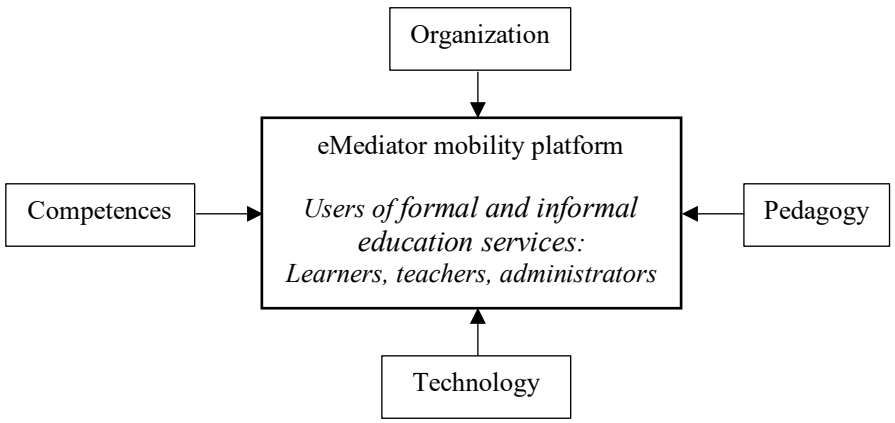
Educational and professional mobility is one of the alternatives in which students and workers gain competencies and search for jobs, training, and internships. In the era of digitalization, information transfer, and active learning [1], human activities become digitalized and informative [2]. Such a motivation built a rationale for creating a dedicated AI-based environment for fulfilling educational and professional needs. This environment is developed within the Erasmus+ eMediator project, which addresses the macro-level priority of digital transformation by developing digital readiness, resilience, and capacity. Creating an electronic

portal offering online education, training, and employment aims to reduce borders and physical barriers. It also helps a learning community get prepared for a market.

This article focuses on a crucial part of the system related to formal and informal educational services. Although there is a generic division into formal and informal education services, it is vital to stress that it is possible to distinguish non-formal and informal learning in some resources. Non-formal learning *usually is structured learning (e.g. in-company training)*, and informal learning *happens naturally as part of diverse activities (e.g. digital skills developed through leisure activitie*s) [3]. The research question concerns the design of the mediator system architecture to provide formal and informal education services. It was assumed that these services should be designed based on four components: organization, competence, pedagogy, and technology [4]. They provide a comprehensive landscape for all users: learners, teachers, and administrators. Such a specific purpose and requirements of the system led to using a qualitative method – a use case which can be used when a system is under construction. The cases are bound by time and activity [5], which creates additional boundaries and limitations for the study.

2. METHODOLOGY

The design of formal and informal education services for the eMediator platform requires a qualitative approach. Since the research problem concerns the design of formal and informal education services for mediator system architecture, answering the question will focus on taking into account the two main limitations: specific users and the four categories (organization, competence, pedagogy, and technology), which create a framework for a newly developed system architecture (Figure 1).



Formal and informal education training users are learners, teachers, and administrators who can personalize the system according to the requirements of a given subject or a teaching module. The four components build a further setting for functionalities, and they are understood in the following manner:

1) Organization component refers to strategic, tactical, and operational levels, which indicate the levels for the system's management and its possibilities.
2) Competence component – is related to knowledge, skills, and attitudes conveyed through educational content and teaching methods.
3) Pedagogy component concerns a holistic approach reflected in learning dimensions: cognitive, emotional, social, and psychomotor.
4) Technology component – depends on projects' assumptions that stress that education and training should be service-oriented and competence-based (with a list of required competencies). Since the assumptions entail personalizing learning and teaching, artificial intelligence will play a crucial role in system development.

Each component requires elaboration and provides a specific context for the design of the service. It will be performed by the description of use cases provided in the Results section.

3. RESULTS

For the eMediator project, the design of formal and informal education services should fit the four interconnected components: organization, competencies, pedagogy, and technology. Regarding **organization** and the design of formal and informal education services, it is essential to think of the process organizationally. Therefore, strategic, tactical, and operational levels were distinguished. The strategic level includes objectives of regional systems as well as professional and personal goals and needs (treated separately). This corresponds to the question: why educational mobility efforts are taken? What are their goals and motivations? The second tactical level includes formal education, non-formal learning and informal learning. The question that will correspond to this level is: what kind of educational effort can be taken? How can the goals and motivations be realized? The third level is operational, and it includes participants in the educational process (teachers and learners) and the main factors that influence the educational process (such as teaching materials, methods, didactic tools which are developed and realized by teachers, and personality, preferences and learning styles, competencies that are connected with a learner. On the operational level, technology and administration play a vital role. Technology creates boundaries for didactic forms and methods, and

administration facilitates the educational process. It is vital to stress that ethical behaviours should govern all organizations of the educational process. Ethics impacts decisions on what is morally correct or incorrect and can impose a specific system of values to be obeyed. Education services can be connected with value co-creation, which is related to transparency between design parties of service, enabling an internally strong network, trust between parties is based on rich cooperation, and shared expertise increases motivation for common value co-creation [6]. This way, formal and informal educational services are realized in a friendly and safe environment. Figure 2 presents the design of formal and informal education services in the mediator ecosystem from the organization's perspective. It is vital for the perspective of "Mobile Education as a Service" stakeholders and customers.

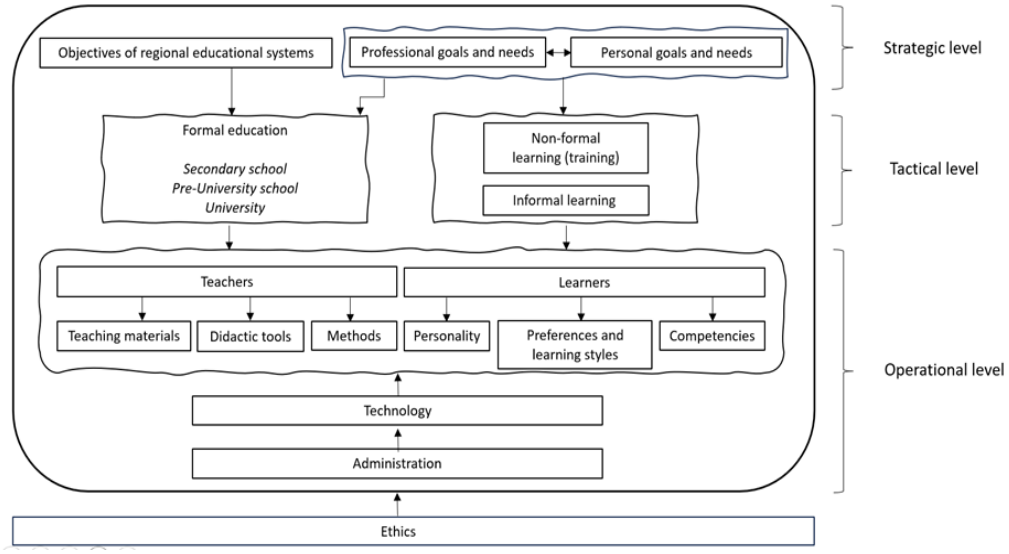


Figure 2. Formal and informal education services from the perspective of the organization

The organization category fits in principles formulated in the project assumptions, specifically in the principle of service-oriented education and the principle of academia-business partnerships. The competence category is related to the principle of competency-based learning. The pedagogy category – is the principle of student-centred education, while technology – is the principle of open resources [7].

From the perspective of **competencies**, both formal and informal learning apply to the main components of competencies: knowledge, skills, and attitudes (Figure 3). Among many approaches concerning competencies, for instance, competence as ability/capability, as a disposition, a process, a relation, quality or state of being,

integration and combination of resources [8], we concentrated on the definition that it is an integrated set of capabilities that arises from clusters of knowledge, skills and attitudes [9] as it reveals a broader approach towards different ways of learning.

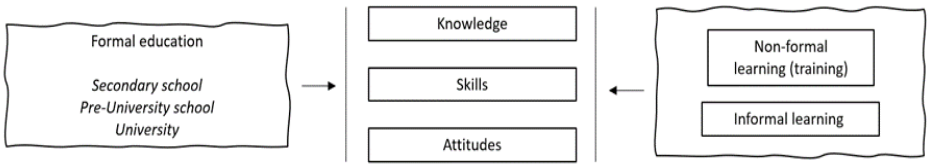


Figure 3. Formal and informal education services from the perspective of competencies

In two, mobility for education and professional development will also apply a **pedagogical component**, in which the education services will focus on four dimensions of learning: cognitive, psychomotor, social, and psychomotor [10]. It also covers experiential learning, which can be realized through game-based activities [11], storytelling [12], and focus on personalization thanks to AI [13] (Figure 4).

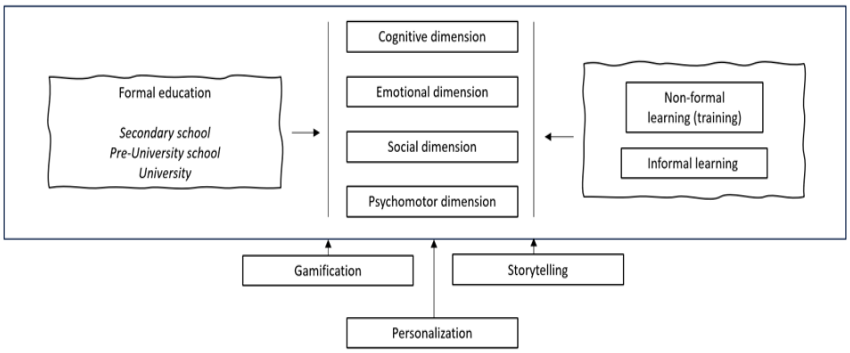


Figure 4. Formal and informal education services from the perspective of pedagogy

Regarding the **technological component**, the main assumptions are that the educational mobility services should be service-oriented and competence-based (with a list of required competencies). They rely on user (external functionality) requirements and software (digital platform) requirements. The system will rely on cloud service and be a digital platform based on existing cutting-edge technologies (machine learning algorithms for big data analytics) (Figure 5). Its architecture is constructed considering further model's extension, enhancement, and User Experience recommendations of education management systems.

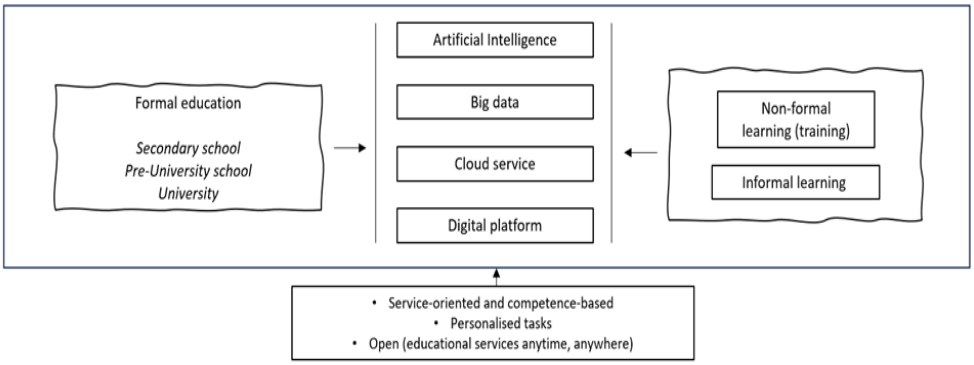


Figure 5. Formal and informal education services from the perspective of technology

To sum up, the presented approaches to designs of formal and formal education services focus on unique features for each category. They provide a framework for dedicated functionalities that will be inbuilt in the system. AI will enable the functions to work across the categories.

4. CONCLUSIONS

The eMediator project created a unique ecosystem that allows education and professional development for all, without boundaries, anytime, anywhere. Digitalization, accessibility, professional development, safety (no exposure to, e.g., biological threats while travelling), and equal chances in education are key advantages that build the rationale for the mobility platform development. The approach to the design of formal and informal educational services, which is based on organization, competence, pedagogical and technological components, allows for the creation of a comprehensive system architecture that fulfils the needs of its users. It provides EU borderless online education mobility, which became a reality by joining the leading education market players in one virtual space. Further implications concern the application of use cases in other, similar systems which can support secondary or vocational education or the development of specialized groups.

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Remark:

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